COMBIVERT

Mat.No.	Rev.
00G6NEZ-0000	1F

KEB

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1. Preface

1.1 General

First we would like to welcome you as a customer of the company Karl E. Brinkmann GmbH and congratulation to the purchase of this product. The enclosed documents correspond to conditions valid at printing. Misprint, mistakes and technical changes reserved.

The instruction manual must be made available to the user. Before working with the unit the user must become familiar with it. This especially applies to the knowledge and observance of the following safety and warning indications. The used pictograms have following significance:

	Danger Warning Caution	Is used, if life or health of the user are endangered or substantial damage to property can occur.
	Attention observe at all costs	Is used, if a measure is necessary for safe and trouble-free operation.
	Information Aide Tip	Is used, if a measure simplifies the handling or operation of the unit.

Non-observance of the safety instructions leads to the loss of any liability claims. This list is not exhaustive.

1.2 Validity and liability

The use of our units in the target products is outside of our control and therefore lies exclusively in the area of responsibility of the machine manufacturer.

The information contained in the technical documentation, as well as any user-specific advice in spoken and written and through tests, are made to best of our knowledge and information about the application. However, they are considered for information only without responsibility. This also applies to any violation of industrial property rights of a third-party.

Selection of our units in view of their suitability for the intended use must be done generally by the user.

Tests can only be done within the application by the machine manufacturer. They must be repeated, even if only parts of hardware, software or the unit adjustment are modified.

Unauthorised opening and tampering may lead to bodily injury and property damage and may entail the loss of warranty rights. Original spare parts and authorized accessories by the manufacturer serve as security. The use of other parts excludes liability for the consequences arising out of.

The suspension of liability is especially valid also for operation interruption loss, loss of profit, data loss or other damages. This is also valid, if we referred first to the possibility of such damages.

If single regulations should be or become void, invalid or impracticable, the effectivity of all other regulations or agreements is not affected.

1.3 Copyright

The customer may use the instruction manual as well as further documents or parts from it for internal purposes. Copyrights are with KEB and remain valid in its entirety.

1.4 Specified application

G6 braking resistors are components designed for inclusion in electrical installations or machinery. They can be sub-mounted or side-mounted to the inverter. The respective load limits are different here.

The used semiconductors and components of KEB are developed and dimensioned for the use in industrial products. If the KEB COMBIVERT F5 is used in machines, which work under exceptional conditions or if essential functions, life-supporting measures or an extraordinary safety step must be fulfilled, the necessary reliability and security must be ensured by the machine builder. The operation of our products outside the indicated limit values of the technical data leads to the loss of any liability claims.

1.5 Product description

Energy is refeed in the DC link during deceleration of drives. This leads to an increase of the DC link voltage. The braking transistor switches and the excess energy is converted via braking resistor into heat in order that the inverter does not release an overvoltage error. The G6 braking transistors are intrinsically safe (see also chapter 3.4).

The braking resistor must be selected according to the application that the permissible load limit is not exceeded.

⚠	Caution when sub-mounted	At non-observance of the load limit the sub-mounted braking resistor can reach temperatures which damage the inverter housing.

2. Calculations

2.1 Selection of braking resistor:

1. Preset desired braking time.
2. Calculate braking time without braking resistor (t_{Bmin}).
3. A braking resistor is necessary if the desired braking time is smaller than the calculated braking time ($t_B < t_{Bmin}$).
4. Calculate braking torque (M_B). Take the load torque into account at the calculation.
5. Calculate peak braking power (P_B). The peak braking power must always be calculated for the worst case (n_{max} to standstill).
6. Selection of braking resistor:
a) Peak power of the braking resistor $P_S \geq$ peak braking power P_B
b) P_N is to be selected according to the cycle time.
   The resistance values shall not decrease the min. permissible value of the braking transistors. The minimum braking resistor can be taken from the technical data of the inverter documentation.
   The maximum cyclic duration of a braking resistor shall not be exceeded. For a longer cyclic duration time special designed braking resistors are necessary. The continuous output of the braking transistor must be taken into consideration.
7. Check, whether the desired braking time (tBmin) is attained with the braking resistor.

Restriction: Under consideration of the rating of the braking resistor and the brake power of the motor, the braking torque may not exceed 1.5 times of the rating torque of the motor (see formula).
When utilizing the maximum possible braking torque the frequency inverter must be dimensioned for the higher current.

2.2 Braking ramp

The braking ramp is adjusted at the frequency inverter. If it was selected too small, the KEB COMBIVERT switches off automatically and error message overvoltage (E.OP) or overcurrent (E.OC) is displayed. The approximate braking time can be determined according to following formula.

Braking Resistors

2.3 Calculation formula

Braking time without braking resistor

$$t_{Bmin} = \frac{(J_M + J_L) \cdot (n_1 - n_2)}{9.55 \cdot (K \cdot M_N + M_L)}$$

Valid range: $n_1 > n_N$ (field weakening range)

Required braking torque

$$M_B = \frac{(J_M + J_L) \cdot (n_1 - n_2)}{9.55 \cdot t_B} - M_L$$

Conditions: $M_B \leq 1.5 \cdot M_N$; $f \leq 70\,Hz$

Peak braking power

$$P_B = \frac{M_B \cdot n_1}{9.55}$$

Condition: $P_B < P_S$

Braking time with braking resistor

$$t_{Bmin} = \frac{(J_M + J_L) \cdot (n_1 - n_2)}{9.55 \cdot (K \cdot M_N + M_L + \frac{P_R \cdot 9.55}{(n_1 - n_2)})}$$

Valid range: $n_1 > n_N$

Conditions: $\dfrac{P_S \cdot 9.55}{(n_1 - n_2)} \leq M_N \cdot (1.5 - K)$
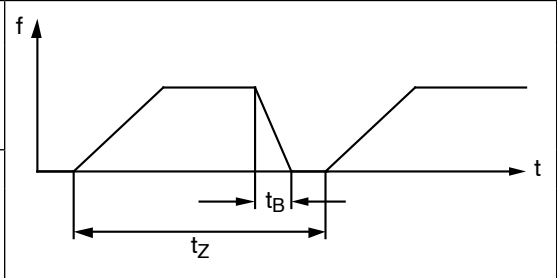
$f \leq 70\,Hz$

$P_B \leq P_S$

Cyclic duration factor

ED for $t_Z \leq 120\,s$

$$ED = \frac{t_B}{t_Z} \cdot 100\,\%$$

ED for $t_Z > 120\,s$

$$ED = \frac{t_B}{120\,s} \cdot 100\,\%$$

Legend			
J_M	=	mass moment of inertia motor	[kgm²]
J_L	=	mass moment of inertia load	[kgm²]
n_1	=	motor speed prior to deceleration	[rpm]
n_2	=	motor speed after deceleration (standstill = 0 rpm)	[rpm]
n_N	=	rated motor speed	[rpm]
M_N	=	rated motor torque	[Nm]
M_B	=	required braking torque	[Nm]
M_L	=	load torque	[Nm]
t_B	=	required braking time	[s]
t_{Bmin}	=	minimum braking time	[s]
t_Z	=	cycle time	[s]
P_B	=	peak braking power	[W]
P_S	=	peak power of braking resistor	[W]
K	=	0.25 for motors to 1.5 kW (default three-phase asynchronous motor)	
		0.20 for motors 2.2…4 kW	
		0.15 for motors 5.5…11 kW	
		0.08 for motors 15…45 kW	
		0.05 for motors > 45 kW	
cdf	=	cyclic duration factor	

3. Technical Data

3.1 General

Part number	R	P$_D$	Terminals		Core cross-section	
	Ω	[W]	[AWG] / [mm²]		[AWG] / [mm²]	
400/480 V inverter (max. DC link voltage 840 Vdc)						
10G6A90-4300	160	200	–	–	16	1.5
13G6B90-4300	110	250	–	–	16	1.5
15G6C90-4300	56	300	–	–	16	1.5
R	*Resistance*					
P$_D$	*Continuous output power at 40° C and a surface over temperature of 200K*					

3.2 Technical data at side-mounted

Cycle time	120 s						
ON time ED	60 %	40 %	25 %	15 %	6 %	3 %	1 %
Overload factor OF	1.5	2.2	3.0	4.2	8.2	13	22

Calculation of peak power Ps:

Peak power Ps = *continuous output power PD • overload factor OF*

The calculated peak braking power PB must be smaller than the peak power PS of the resistance. Please contact KEB if the value is not reached.

3.3 Special features at sub-mounted version

Cycle time		120 s
Max. ambient temperature		45 °C
Max. housing temperature inverter		125 °C
Maximum permissible continuous output power at max. 840 Vdc	10G6A90-4300	40 W (corresponds to 1 % ED)
	13G6B90-4300	60 W (corresponds to 1 % ED)
	15G6C90-4300	90 W (corresponds to 1 % ED)

| ⚠	Caution when sub-mounted	At non-observance of the load limit the sub-mounted braking resistor can reach temperatures which damage the inverter housing.

3.4 Intrinsic safety of braking resistors

Intrinsically safe means that the internal wound wire resistor at overload (overheating) melts like a fuse. There is no short-circuit or ground fault.
As a consequence the inverter goes into error state „E.OP" at the next deceleration process (when the braking resistor is required).
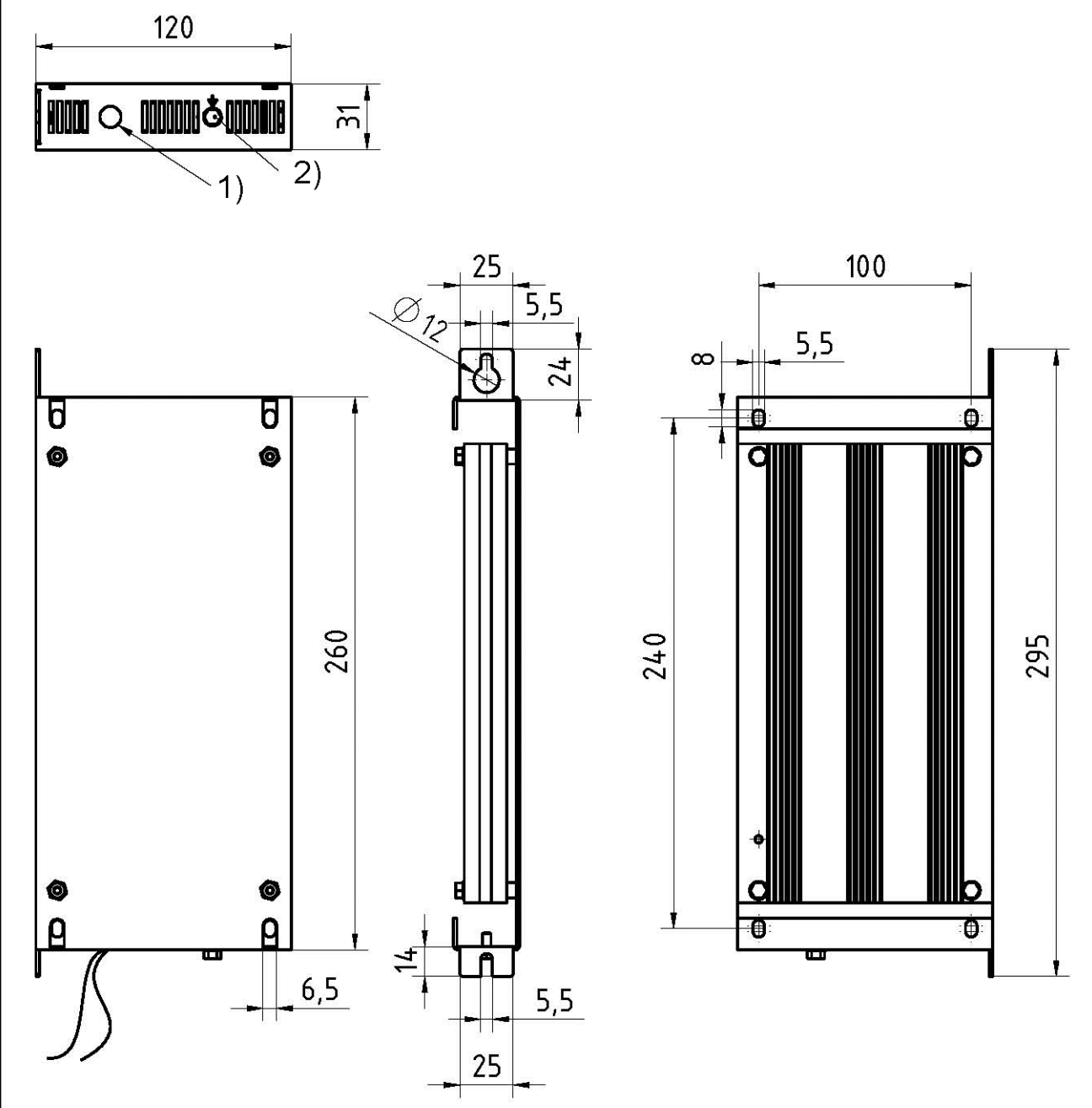
3.5 Dimensions sub-mounted/side-mounted for housing size A and B
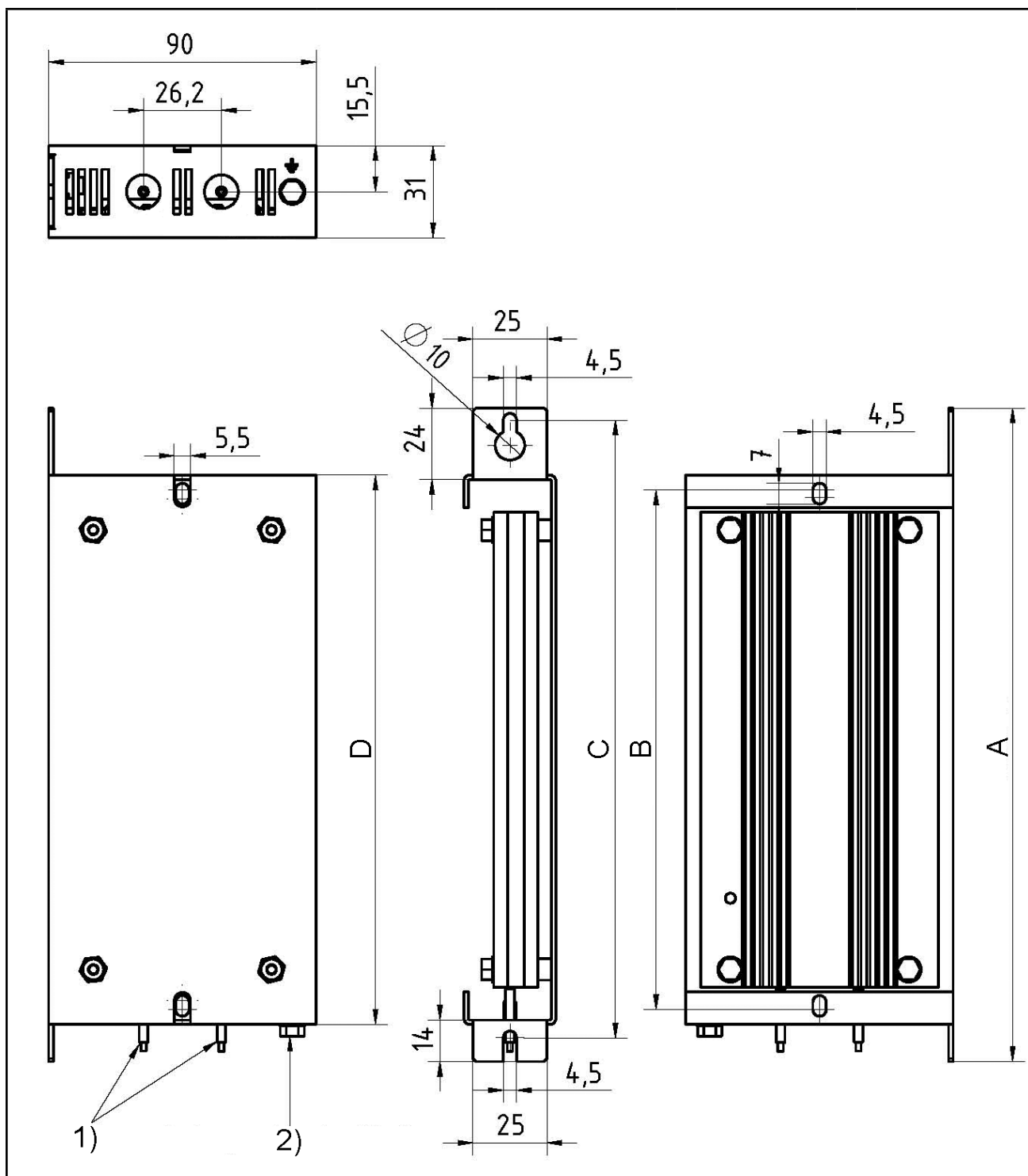
1) Connection cable; 2) Earth connection screw M4x8

| Material number	A	B	C	D
10G6A90-4300	220	175	208	185
13G6B90-4300	285	240	272	250

3.6 Dimensions sub-mounted/side-mounted for housing size C

1) Connection wires; 2) Earth connection screw M4x8

Lenght of the connecting wires: approx. 200 mm

3.7 Installation instructions

Braking resistors can evolve very high surface temperatures during normal operation. The following points must be considered absolutely for safe operation:

•	Select minimum distances to adjacent materials/surfaces such way that neither fire risk nor malfunctions increased by ambient temperature releases.
•	Sufficient heat dissipation must be available when the unit is installed in a control cabinet.
•	A warning notice "hot surface" must be placed in case of structural measures if a protection against contact for the service personnel cannot be ensured.
•	Make fire preventions if necessary.
•	Installation positions and minimum distances

Side view with sub-mounted braking resistor	Front view with side-mounted braking resistor
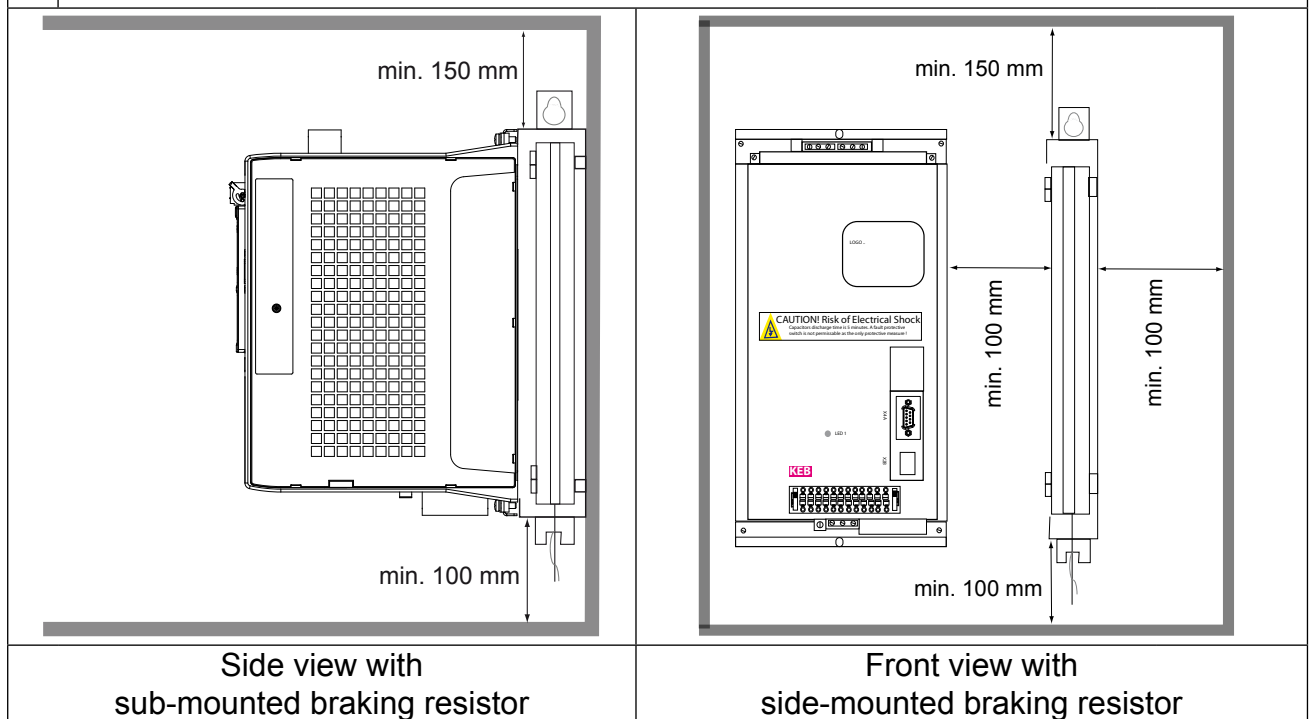
3.8 Connection of a braking resistor without temperature monitoring
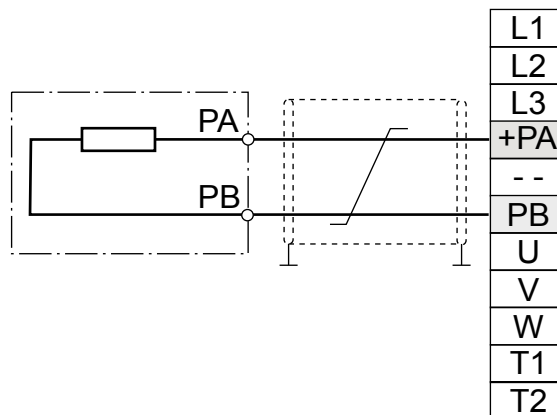
4. Certification

4.1 CE Marking

CE	By adjacent logo on the product, we confirm that the product meets the product-specific, applicable European Directives.

The resistors are marked according to the Low-Voltage Directive CE.

4.2 UL Certification

c US	An UL certification of the resistors is marked by adjacent logo on the product.

The resistors are UL approved for the United States (NMTR2) and for Canada (NMTR8) in file E212934 and approbated with KEB inverters type G6.

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